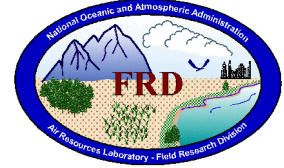


FRD Activities Report July 2001



Research Programs

CBLAST-Low

The Coupled Boundary Layer Air-Sea Transfer light wind (CBLAST-Low) pilot study is well underway off the south coast of Martha's Vineyard, Massachusetts. The LongEZ research aircraft (Figure 1) has flown 11 missions (~ 26 hour) to date and will continue to do so until August 8. The objective of CBLAST-Low is to examine air-sea transfer processes under very light wind ($< 3 \text{ m s}^{-1}$) regimes. These processes are not well understood and are inadequately modeled.



Figure 1. The LongEZ returning to Martha's Vineyard airport from a CBLAST-Low mission.

So far, all sensors and electronics have worked exceptionally well. A number of significant improvements have been made since the last air-sea interaction study (the Shoaling Waves Experiment or SHOWEX) which was conducted on the Outer Banks of North Carolina in November 1999. Aircraft and ground station global positioning systems (GPS) have been upgraded from a single frequency to a dual frequency system. This allows greater precision in determining aircraft position. The new fast ultra sensitive temperature (FUST) probe has been incorporated into the turbulence sensor system. This sensor will be able to resolve very fast, small scale turbulent fluctuations. A new fast response (12 KHz) laser has replaced a slower (2 KHz) laser altimeter. This laser, in conjunction with two other 2-KHz lasers are used to determine sea surface wave properties (e.g., slope, phase, height) greater than 1 m in length. A fourth laser has been incorporated into the array at a 15 degree angle from the vertical. This so-called "glint" laser will be used to look at wave slopes when the ocean surface becomes smooth. Finally, the steps have been taken to temperature control the downward looking radiometer which is used to measure sea surface temperature.

Mean values of momentum, sensible, and latent heat fluxes for eight flights are shown in Figure 2. Similarly, mean values of stability (z/L), roughness length, and drag coefficient are in Figure 3. The first two days of the experiment (July 21 and 22) were conducted in unstable conditions with offshore flow. However, southwesterly onshore flow on July 23 and 25 helped create a stable marine atmospheric boundary layer. The momentum flux increased

over these four days but the sensible heat flux, while very small, reversed its direction. The latent heat flux, interestingly enough, become slightly negative on July 25, a day in which humidity values were quite high. A storm system and cold front pushed through New England on July 26, after which an offshore flow reestablished an unstable MABL. Note that the latent heat flux quickly became quite significant. Another interesting feature is the estimation of the roughness length which is one to two orders of magnitude smaller than the Charnock prediction for z_0 .

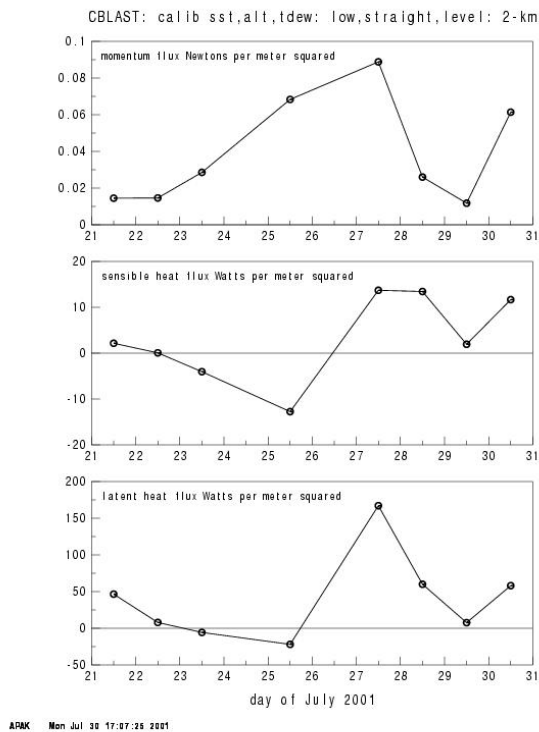


Figure 2. Mean values of momentum, sensible, and latent heat flux.

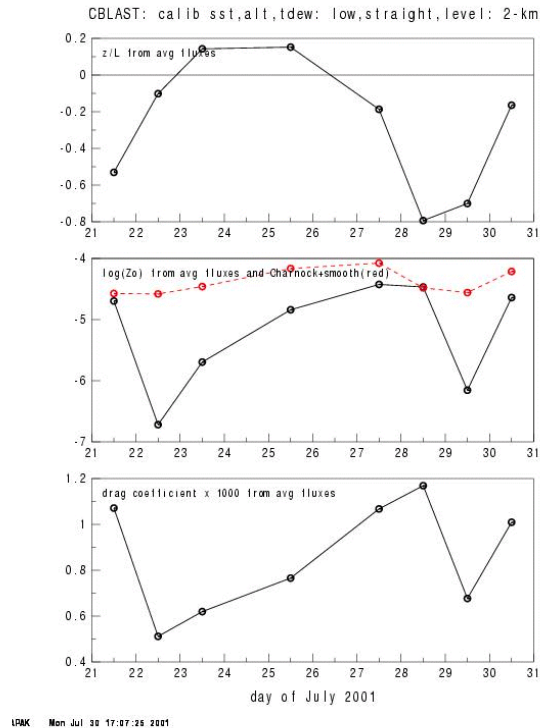


Figure 3. Mean values of stability (z/L), roughness length, and drag coefficient.

The next set of graphs are a composite of 2-km long flux legs over the first four flights (July 21, 22, 23, and 25). Friction velocity is directly related to wind speed, however, with considerable scatter. Even more dramatic is the scatter of the roughness length plotted as a function of wind speed. Some of the largest values of z_0 are seen for wind speeds less than 4 m s^{-1} . Drag coefficient also significantly increases for winds less than 3 m s^{-1} . Finally, the drag coefficient is plotted as a function of stability. For these data, the largest values are found for slightly unstable condition. (Jerry.Crescenti@noaa.gov, Jeff French, and Tim Crawford)

CBLAST-Hurricane

Work continues on the development of an instrument package that will be used to measure fluxes in the lowest levels of the atmosphere in hurricanes from NOAA's P3 aircraft. As part of a joint project, including 2 NOAA labs, NASA and 3 research institutes, we will install a system to measure three dimensional wind velocity, temperature, and water vapor. The P3 system is similar to that currently being used on the LongEZ. Assembly of the data acquisition system has already begun. Crucial hardware for mounting the BAT probe, GPS antennas and other instruments were shipped to AOC where aircraft engineers will begin modifications necessary to accommodate the new package. Installation of the hardware components is expected to be finished on one of the P3s this fall, with the second P3 being completed next spring. This should allow for ample time before flight testing during the 2002 hurricane season. (Jeff.French@noaa.gov, Tim Crawford)

AFTAC 2001

Post-processing of the data collected while in the field at Dugway Proving Ground, Utah, (DPG) in April has been completed. A total of 7 tests were conducted during the deployment. Each test consisted of a 4-hour release of SF₆ tracer into the mobile 70-ft tall Dugway stack, with a simultaneous real time sampling of the resultant SF₆ plume. Flow through the stack was assisted with a DPG-supplied Dash-60 start cart. An example of the SF₆ tracer release flow rate and cumulative mass released are shown in Figure 4.

Plume sampling usually continued up to 4 hours after the release had ended. The plume was sampled with three mobile real-time sampling units that traversed the plume along established routes at increasing distances on DPG, on the Wendover Bombing Range, on I-80, or along the Pony Express

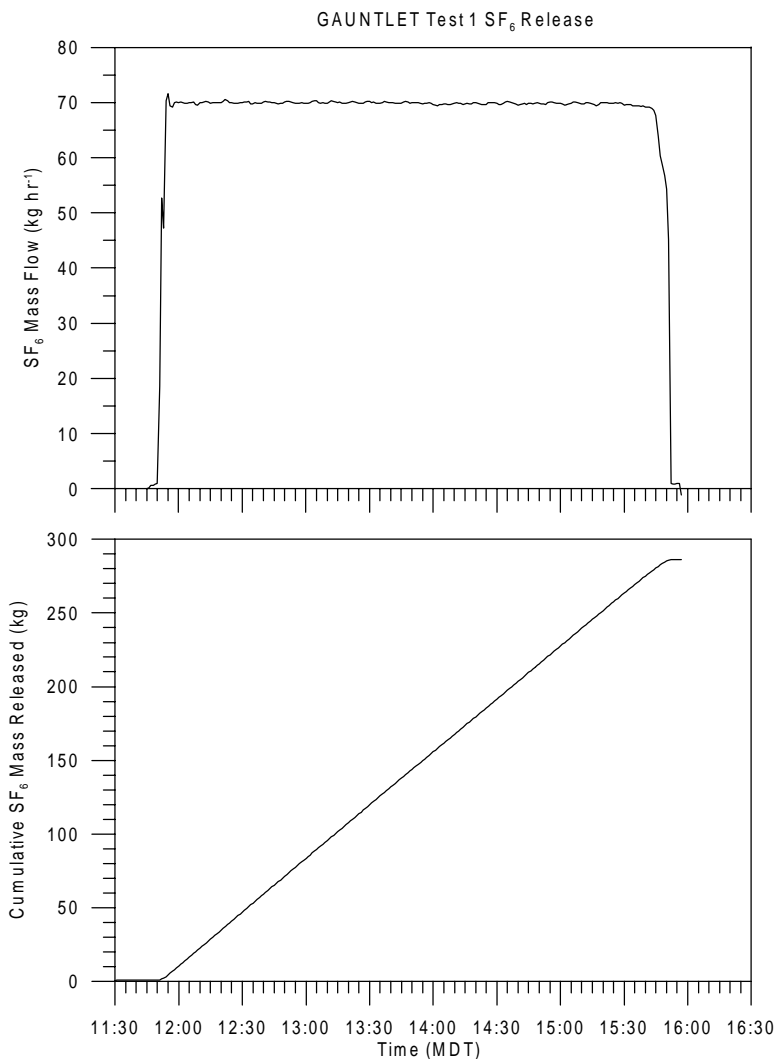
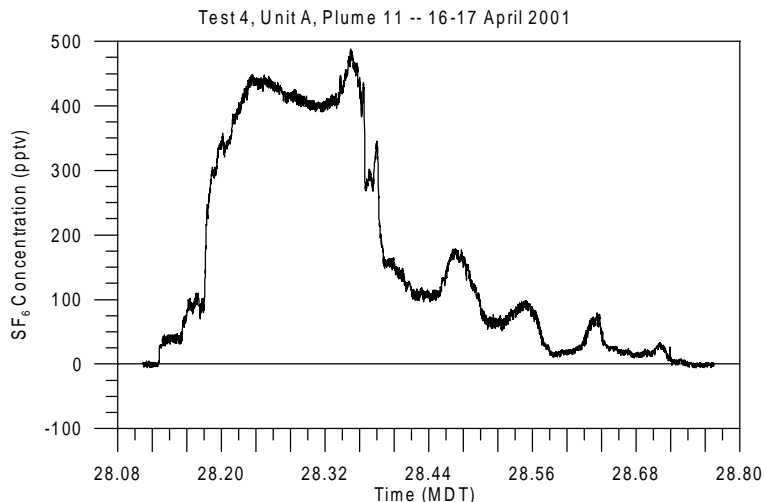


Figure 4. Test 1 SF₆ release rate from the mass flow meter (top) and cumulative mass of SF₆ released from the SF₆ cylinder load cells (bottom).

Road. When the sampler operator determined that the plume had been crossed, plume width, maximum concentration, and location of the maximum concentration were subsequently determined and relayed via cell phone and DPG radio to the control point for review by the FRD and AFTAC test controllers. An example analyzer output and map indicating the plume location is shown in Figure 5.



A total of 247 sampling traverses were made by the three mobile units. Ninety-three of these traverses resulted in null passes where no SF_6 was detected. The remaining 154 traverses yielded measurable SF_6 plume concentrations. Sampling Unit A made a total of 116 traverses, Unit B made a total of 58 traverses, and Unit C made 73 total traverses in only 5 tests. Unit B made considerably less traverses than the other units because 1), the roads were much rougher, which required the SUV driver to travel slowly in order to maintain vehicle control, and 2) the route was not perpendicular to the average SF_6 plume, which resulted in longer travel distances.

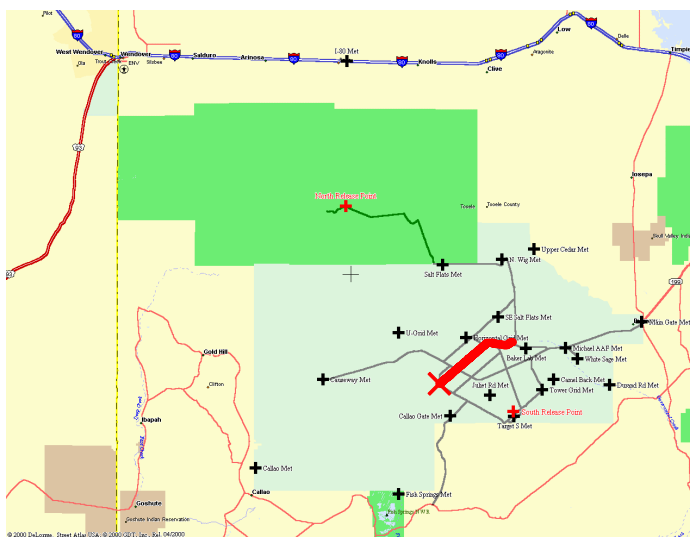


Figure 5. Trace of SF_6 for plume traverse number 11 during Test 4, obtained by mobile real-time SF_6 Sampling Unit A (top) together with location of the plume (bottom).

An assemblage of plume crossings was completed for each test. Maximum plume concentration was plotted against time and overlaid on a map of the sampling routes. The composite graph and map for Test 4 is shown in Figure 6. The graph in the upper-left corner indicates decreasing SF_6 concentration with distance from the south release point, with Sampling Unit A being closest to the release point and Sampling Unit B being the farthest removed. Arrival time of the plume can also be seen with Sampling Unit C observing the arrival time some 4 hours after Sampling Unit A began to measure the plume. Average distance from Sampling Units A, B, and C to the south release point were 20, 50, and 75 km, respectively. (Kirk.Clawson@noaa.gov, Roger Carter, Neil Hukari, Shane Beard and staff)

Tracer Technology

The new version of the Automated Tracer Gas Analysis System (ATGAS) has undergone initial testing this month. A test version of the software is operational, allowing all of the components to be operated and tested. We have verified that it can detect SF₆ at similar levels to the old system. The new system is about 70% smaller than the old system and should be about 30% faster once tuning is complete. It should be easier to use and offer more flexibility. The smaller size will make transporting of the analysis capability to field locations much easier and more cost effective. (Roger.Carter@noaa.gov, Debbie Lacroix, Shane Beard)

Hurricane Balloon

On July 10, 2001, a meeting was held in Jacksonville, Florida, to discuss safety issues concerning the flight of our hurricane balloon and the NASA Aerosonde in hurricanes. The meeting was held with the NASA Aerosonde group, Aerosonde Company personnel, NOAA AOML/HRD, NOAA AOC, the USAF 53rd Weather Reconnaissance Squadron (Hurricane Hunters), and NOAA ARL/FRD. At the end of July, the results of the meeting are still not formally signed off by AOC and the 53rd Weather Reconnaissance Squadron. They are in the process of reaching an agreement on the Aerosonde operating requirements and constraints. After the aerosonde operating constraints have been agreed upon, they will incorporate them into the final hurricane balloon letter in the hope of getting it signed off quickly.

Although not official yet, listed below are the items discussed in the meeting that are specific to the hurricane balloon that the AOC and the 53rd Weather Reconnaissance Squadron would require prior to the first balloon launch into a hurricane.

- A fail-safe termination valve on the balloon. If power, connection, communications, or the processor fail the balloon flight will terminate by releasing the lift gas. A normally open valve will need to be used. Some change in software and hardware will need to be made to make this change.
- CARCAH will have final decision on starting and terminating any balloon flight and will be kept informed of balloon status at all times by a NOAA/UH person.
- A maximum altitude balloon termination. If the balloon exceeds a preset altitude, the lift gas release valve will open, terminating the balloon flight.
- Termination validation or statistics showing reliability of termination under processor failure, communications failure, maximum altitude exceeded, or operator commanded cut- down. The hurricane balloon needs to send back a message confirming balloon termination. This cannot be guaranteed because a processor failure or communication failure could possibly stop this. We are

presently gathering data on the reliability of the communications and have placed an order for valves that will meet the fail-safe requirements.

- Reliability data of the balloon in a hurricane or other severe weather conditions.
- We will not be sending balloons into hurricanes until we have convinced them that it is safe.

Those attending this meeting included:

NASA: Steve Hipskind, Mike Craig, Robbie Hood and Geary Tiffany

NOAA AOC: Jim McFadden, Phil Kenul

NOAA HRD: Frank Marks

53rd Weather Reconnaissance Squadron: James Dignan, Robert Katz, Jeff Wright

Aerosonde: Greg Tyrrell

NOAA ARL/FRD: Randy Johnson

While we were at the Jacksonville meeting, Qualcomm called to notify us that they are no longer going to sell or support the 1620 satellite data modem. Although Globalstar told us they anticipate making arrangements with Qualcomm to continue the manufacture and support of the 1620 modem, we must assume that this is not going to happen. We have started changing the hardware to use the 1600 mobile phone. This will require some hardware changes, but seems to be the most workable solution at this time. Actual testing of the 1600 shows very good reliability. The system indicates about a 2% data error rate and an average connection time of 1.5 to 2 hours (the connection is broken any time an earth gateway changes due to available satellites) Time to reestablish communication averages less than 1 minute. (randy.johnson@noaa.gov, Roger Carter, Shane Beard)

CASES-99

Work has now started on completing the postprocessing of the LongEZ data collected during CASES-99. The first step was to recompute the differentially corrected aircraft position and velocity data using a program called flykin. The differential corrections were originally computed using another program called c3nav, but flykin produces better results. For example, the aircraft vertical velocity computed from c3nav contains some residual noise that increases the vertical velocity's standard deviation by about 8 cm/s. In flykin, the residual noise increases the standard deviation by only 1-2 cm/s. Keeping the noise to a minimum is particularly important for CASES-99, because the data were collected in the nighttime boundary layer when the turbulence is relatively light. (Richard.Eckman@noaa.gov)

Cooperative Research with INEEL

INEEL Support

Several requests for dispersion modeling support came in to FRD in July. Stoller Corporation made a request for annual-average concentration estimates based on year 2000 data. These estimates are computed each year using a version of the MDIFF model. A meeting was held with Stoller personnel to determine whether the procedures used in generating these estimates can be streamlined. It was determined that some of the steps in the current procedure have become outdated and can be eliminated. A second modeling request was related to the dispersion and deposition of small airborne particles in various size ranges. This request will likely require the use of a model other than MDIFF, because MDIFF currently does not include parameterizations for gravitational settling. A third request came from Argonne National Laboratory-West, and was related to the atmospheric conditions which would lead to a “worst case” dispersion event. (Richard.Eckman@noaa.gov, Kirk Clawson)

Emergency Operations Center (EOC)

It's that time of year again. A range fire occurred 36 miles west of Idaho Falls near Middle Butte on the southeastern corner of the INEEL. The blaze started about 2:30 p.m. on Sunday, July 8, 2001, and was quickly put out by BLM and INEEL firefighters. The cause for the fire is unknown. Fortunately, the fire was contained to an area of about 120 acres. In response to this fire, the Emergency Operations Center (EOC) was activated. Jerry Crescenti and Brad Reese responded to the EOC activation and provided real-time meteorological support. The NOAA support team kept a close eye on a cluster of thunderstorms south of the INEEL which posed a threat to the fire because of strong outflow winds that would help spread the blaze. (Jerry.Crescenti@noaa.gov, Brad Reese)

Two other drills at the INEEL tested the activation of the EOC. Kirk Clawson and Brad Reese responded to the EOC on July 11 for a mock explosion and fire at the Idaho Nuclear Technology and Environmental Center. Fissionable materials were supposedly released. MDIFF model output of plume footprints and short range forecasts were disseminated to the Emergency Director and other key players. Two weeks later, this same scenario was repeated. Rick Eckman and Debbie Lacroix represented FRD in the EOC. (Kirk.Clawson@noaa.gov, Brad Reese, Rick Eckman, and Debbie Lacroix)

INEEL Mesoscale Modeling

Near the end of July, the dual-processor Alpha computer used for the MM5 forecasts at FRD suffered a hardware failure and is totally offline. Fortunately, the system is still under warranty. The system manufacturer first sent a new motherboard to FRD, but this did not fix the problem. The innards of the system have now been sent back to the manufacturer for diagnostics and repair. (Richard.Eckman@noaa.gov)

INELVIZ Training

A training course for INELVIZ users was held on July 24. This course, on the use and operation of the INELVIZ system, is conducted periodically for new users and current users who would like a refresher course. Brad Reese discussed the use and operation of the system, Roger Carter talked about potential problems and how to deal with them, and Jerry Sagendorf presented a description of the model and how it works. (Brad.Reese@noaa.gov, Roger Carter)

Other Activities

Travel

July 9-11, Randy Johnson, to Jacksonville, Florida, to attend the planning meeting with NASA, AOC and the 53rd Airborne for the Hurricane Balloon project.

July 18-26, Jeff French to Martha's Vineyard, Massachusetts, to participate in the CBLAST-Low Pilot study.

July 18-August 10, Jerry Crescenti and Tim Crawford to Martha's Vineyard, Massachusetts, to participate in the CBLAST-Low Pilot study.

July 23-July 25, Tom Watson, to Boulder, Colorado, to attend the NWS Technology Infusion Planning Meeting.